

EVALUATION ON BENEFITS AND PROBLEMS OF CONVENTIONAL AND
BIM BASED DOCUMENTATION THROUGH COMPARISON METHOD

REZA BARATI

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To;

My Parents

&

My family

Thanks for your pray, attention and spiritual support

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ABSTRACT

Documentation is an important part in the process of construction. Currently, the conventional documentation method such as Computer Aided Design (CAD) is more commonly used in construction project. New modern approaches like Building Information Modelling- based (BIM-based) help in improvising the quality of construction documentation. There are main gaps between conventional-based documentation process (CAD) and BIM-based documentation process including fragmented nature of the software, lack of collaboration and integration between involved parties, considerable amount of missing data and also lack of capability of applicable visualization. This study, therefore, aim to evaluate the benefits of BIM based documentation with the attention to highlight the problems from CAD conventional-based documentation. The objectives used to achieve the aim are by identify the problems of the Conventional-based documentation using CAD, investigate the benefits, compare the differences and evaluate the benefits and problems of the documentation process of between BIM-based and conventional CAD methods. The study is carried out based on questionnaire survey within construction companies in Singapore. The data is analyzed using statistical analysis of average index. The differences between BIM-based documentation and conventional CAD documentation are BIM approach able to create smart 3D model, create 4D model by adding time dimension into the model and 5D model by additional aspect of project cost. In conclusion the benefits of the BIM-based documentation could overcome the majority of the conventional-based documentation's problems that, except the minor indicators, the main outcomes of project was conformed the hypothesis of the research.

ABSTRAK

Dokumentasi adalah bahagian yang penting di dalam proses pembinaan. Pada masa ini dokumentasi semasa banyak menggunakan kaedah konvensional seperti *Computer Aided Design* (CAD). Pendekatan baru yang moden seperti BIM-based membantu meningkatkan mutu dokumentasi pembinaan. Terdapat jurang utama antara proses dokumentasi CAD konvensional dan proses dokumentasi *Building Information Modelling – based* (BIM-based) termasuk kekangan semulajadi perisian, kekurangan intergrasi dan kolaborasi antara pihak terlibat, amaun kehilangan data dan keupayaan yang lemah kepada aplikasi visual. Oleh yang demikian, kajian ini bermatlamat menilai faedah dokumentasi BIM-based dengan tujuan mengenegahkan masalah-masalah dokumentasi daripada penggunaan CAD. Objektif kajian yang digunakan ialah menyiasat, membandingkan perbezaan dan menilai faedah serta masalah-masalah di antara proses dokumentasi kaedah CAD dan BIM-based. Kajian ini telah dilaksanakan melalui soal selidik di kalangan syarikat pembinaan di Singapura. Analisis data adalah menggunakan analisis statistik indeks purata. Perbezaan dokumentasi antara konvensional CAD dan BIM-based adalah pendekatan BIM boleh mewujudkan model 3D cerdik, mewujudkan model 4D dengan memasukkan dimensi masa, dan model 5D dengan aspek mengambil kira kos projek. Rumusannya faedah-faedah daripada dokumentasi BIM-based boleh menyelesaikan banyak masalah-masalah utama daripada dokumentasi konvensional CAD.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Currently, the industry is facing enormous technological and institutional transformations with their resultant difficulties and challenges. One very important instrument to such change is the use of information technology and application of sustainable practices. According to Levitt (2007) three emerging trends suggest the need to broaden the frame of future construction engineering and management research in several ways: better integrated delivery of construction; new governance structures for projects that can support a more global construction industry; and enhanced documentation through new approaches, methods, and information technology.

Bakens (1997) suggested that growing partnership between research community and industry, internationalization of competition and collaboration in the research community, growing emphasis on integrated topics and approaches in research, information technology in construction, electronic collaboration, and sustainable development and construction are the six international research trends and priorities in the construction industry.

The 21st century engineer and architect must be able to deal with a rapid pace of technological change i.e. conventional documentation methods such as CAD, a highly interconnected world, and complex problems that require multidisciplinary solutions. Both architecture and engineering professions are embracing new modes of interdisciplinary information sharing and focusing on two emerging and fast growing concepts: building information modeling _BIM_ and novel methods of documentation. A mutually beneficial industry/academia collaboration will lead to a growth in strategic research and also would address concerns of Issa and Anumba (2007) about computing and information technology research in civil engineering and architecture being self-fulfilling rather than industry transforming.

Over the years, there has been a significant demand for a positive attempt to ensure that construction projects are executed in accordance with the original intention for which such projects were conceived.

Project documentation and monitoring have been identified as management tools for achieving the above objectives and ideals. For the avoidance of doubts, documentation is defined as:

- The process of providing written information.
- Document provided as a reference or evidential material.

Documentation plays a major role in every construction project. The nature of a construction project is such that necessitates the generation of a wide range of information. This information must be collected and stored not only because they define the unique nature of a construction project, but also to preserve memory and act as a reference or evidential material.

The development of 2D as-built drawings through field survey is a time consuming process and, oftentimes, not accurate. BIM, supported by a centralized database, allows as-built models to be modified during construction to record geometrical variations in building components.

However, upgrading to BIM from a 2D documentation system is more than simply making a change in CAD software. Rather, BIM is a completely different method of communicating building design information. To accommodate the transition, it is likely that there will be a significant enhancement of the import capabilities of BIM software (Eastman, et al. 2008).

1.2 Background of Study

Some scholars have studied comparatively BIM and CAD processes and addressed their relevant issues and attributes.

Mehmet F. Hergunsel (2011) studied 3D, BIM-based scheduling, visualization and cost estimation potentials in three phases of pre-construction, construction and post construction and validated it by modeling a prototype of a research construction as a 4D BIM model and then integrated it with dynamic scheduling system obtained from Navisworks. He concluded that the Revit house model demonstrates benefits of parametric modeling in comparison to two dimensional computer aided drafting. The parametric model denied overlapping of the elements. There were no errors, omissions or conflicts of information at different views. Moreover, the role of Navisworks application as a successful tool for integrating project documentation was highlighted.

Andreas F. Phelps et.al (2011) investigated BIM capabilities in reducing wastes of material and time by modeling a concrete construction case study in the Revit software. They found that BIM provides a master object in which most of the project information can be captured. This minimizes the need to manage multiple documents specially when they are to be modeled and created with conventional documentation methods- their respective administrative issues, and interrelation with other objects. In the implemented case, concrete quantities are extracted from the accurate model and used to order concrete. The precision of the model-based

quantity survey enabled the project to order the appropriate amount of concrete, reducing the concrete wastes.

Raymond Rohena (2011) examined BIM utilization effects on a Naval construction projects to analyze presented road map to implement BIM in such constructions. He modeled the case in the Revit architecture and compared its features with 2D drawing method. It was observed that by incorporating BIM, the level of details required eliminate physical and sequence conflicts prior to construction. Furthermore, it was able to increase the collaboration level of project by minimizing occurred clashes among all disciplines in both design and construction phases.

1.3 Problem Statement

Currently, 3D object-oriented computer-aided design _CAD_ software models serve as communication between planning and design phases. These 3D models also have been used during preconstruction to resolve constructability problems, conduct interference analysis, and to perform scheduling and hazard analysis.

BIM represents real world elements such as walls, doors, and windows as three-dimensional _3D_ objects. In addition to geometry details, other information can be attached to these objects including manufacturers, fire rating, schedule, and cost estimates. Another BIM advantage is the ease to insert, extract, update, or modify digital data by owners, clients, engineers, architects, contractors, suppliers, and building officials.

The essential difference between BIM and CAD is through the use of objects rather than abstract shapes. A door is not merely a line and an arc in a BIM model; it is a graphic object with mathematical and other properties that reside in a database.

Once a door is created, the software automatically includes it in the door schedule. If the door is graphically changed on the drawing, the attributes in the schedule are automatically adjusted. The most immediate and profound attribute of a BIM model is its ability to facilitate visual decision making. Geometrically accurate 3D representations of any portion of the building can be quickly derived. Unlike 2D drawings which are frequently schematic in nature, BIM models require precise information at an early stage of design. Complete and geometrically accurate 3D views of design allow for quicker and more informed decisions by all members of the project team. Design alternatives are easier to generate and understand.

Traditional 2D coordination drawings are difficult to interpret. The ease of finding conflicts and errors in 3D is one of the significant benefits cited by early adapters of BIM technology and leads to fewer RFIs and change orders.

The ability of BIM software to solve complex geometric equations and process large amounts of data allows it to identify spatial conflicts between building components, which enables the design team to correct these problems well in advance of construction operations.

When subcontractors and fabricators are involved in the early stages of design development, their specialized knowledge is captured in the model. Construction sequencing and fabrication can be evaluated at the design development phase. Unlike the 2D drawing process, the first object drawn in a BIM design may still be present in the final construction documents.

Virtual construction sequencing, also known as 4D, allows contractors to understand the spatial dimension of their critical tasks, to avoid conflicts between trades and to choreograph the job site efficiently. The Contractor can initiate staging and sequencing plans at an early stage with BIM.

However, little has been done to implement BIM beyond the use of these models in conventional documentation process (CAD) albeit a substantial amount of information is still collected and transferred to the owner in boxes or file cabinets.

This information, including requests for information _RFI_, schedules, submittals, change orders, or as-built, rarely serves as a reliable database for future decision making and would be more effective if incorporated into the BIM.

All in all, by a holistic view on the previously mentioned gaps between conventional-based documentation process (CAD) and BIM-based documentation process, some general problems such as fragmented nature and lack of collaboration and integration between involved parties, the considerable amount of missing data and the lack of capability of applicable visualization are among of major issues which can be improved and resolved by incorporating BIM processes and tools in the documentation phase of any project.

1.4 Aim of Study

The aim of this study is to evaluate the benefits of BIM based documentation to cover and resolve the problems the conventional–based documentation.

1.5 Objectives of Study

1. To identify problems of the Conventional–based documentation using CAD.
2. To investigate the benefits and problems of using the BIM-based documentation.
3. To compare the differences between BIM-based documentation and Conventional–based documentation.

4. To evaluate the benefits, abilities and problems of the documentation process of BIM based documentation.

1.6 Main Hypothesis

The benefits of the BIM –based documentation can cover and resolve the problems of the conventional based documentation.

1.7 Research Questions

1. What are the problems of the Conventional–based documentation using CAD?
2. What are the benefits and problems of using the BIM-based documentation?
3. What are the differences between BIM-based documentation and Conventional–based documentation?
4. What extent the benefits of the BIM –based documentation can cover and resolve the problems of the conventional –based documentation?

1.8 Scope of Research

To achieve the aim, an administrative building of a power plant project located in Najaf, Iraq, as the case study, has been chosen. The cause of selecting this project is based on my last personal experience which can improve the findings accuracy.

The total area of this two story building amounts to 1700 m². This building constructed based on the reinforced concrete frames and brick walls. From a climate perspective, the case study is in the hot and dry area. Besides other important factors, this characteristic of the project can create possibilities to analysis energy efficiency.

Further, amongst the whole documentation process, the project will focus on the contract documentation (Drawing; ii) specification; iii) Bill of quantity; iv) Project Health and Safety Plan; v) Planning and scheduling).

1.9 Research Methodology

To achieve the goal of the research, in addition to the literature review, the chosen methodology that shows as follow diagram (Figure 1.1).

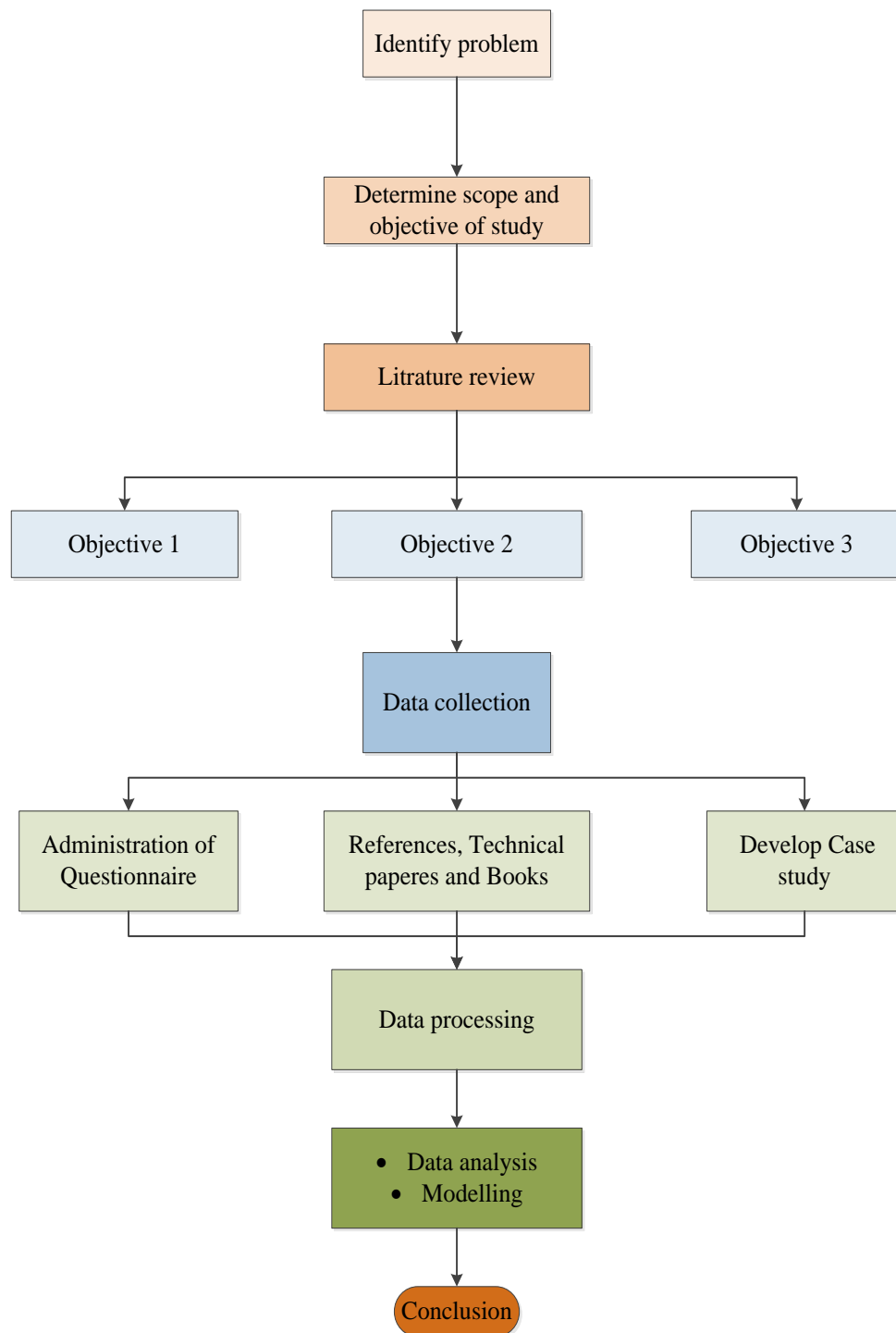


Figure 1.1 Flowchart Diagram of the Research Process

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